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A daily diary study of stressful and positive events, alcohol use, and addiction severity among heavy drinking sexual minority men

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Abstract

Background—The purpose of this study is to examine the conditions under which daily stressful and positive events are associated with alcohol use among heavy drinking sexual minority men (SMM). Specifically, we examined the moderating effects of two indicators of alcohol addiction severity (i.e., alcohol dependence severity and negative drinking consequences) on the associations between daily stressful events and alcohol use and between daily positive events and alcohol use among heavy drinking SMM.

Procedures—Secondary data analyses were performed using data from a randomized controlled trial of heavy drinking and treatment seeking SMM who were assigned male at birth (N = 200). Participants responded to a daily survey delivered via interactive voice recording (IVR) and the first seven days of the IVR were analyzed for this study.

Results—While accounting for age, treatment condition, weekday/weekend, and baseline drinking, stressful and positive events were both associated with increased daily drinking; however, indicators of alcohol addiction severity moderated these associations. For heavy drinkers with high alcohol addiction severity, daily stressful events were not associated with alcohol use, and daily positive events were associated with increased alcohol use. In contrast, for heavy drinkers with low alcohol addiction severity, daily stressful events were associated with less drinking, and daily positive events were not associated with alcohol use.

Conclusions—The findings of this study indicate that alcohol addiction severity plays a key role in explaining when daily stressful or positive events are associated with daily alcohol use among heavy drinking SMM.

Keywords

Sexual Minority Men; Stress; Positive Events; Daily Drinking; Addiction Severity

1. Introduction

Alcohol use disorder (AUD) is prevalent among adults in the United States (SAMHSA, 2012), and some subgroups who are at greater risk. Gay, bisexual, and other men who are attracted to or have sex with men (i.e., sexual minority men; SMM) are at an increased risk for alcohol and substance use disorders and related problems than heterosexual men (Cochran and Mays, 2009; Conron et al., 2010; Lipsky et al., 2012; McCabe et al., 2009; Mereish and Bradford, 2014). Although sexual orientation disparities in heavy alcohol use and AUD are sometimes inconsistent among men and vary across racial groups (Gilbert et al., 2015; Gilbert et al., 2017; Hughes et al., 2016), meta-analytic research has found that SMM is at 1.5 times as likely to meet criteria for alcohol dependence than heterosexual men (King et al., 2008). Concomitantly, research has found that heavy alcohol use is associated with health risks for SMM, including risky sexual behaviors and higher risk for acquiring and/or transmitting HIV among SMM (Colfax et al., 2004; Kahler et al., 2015; Woolf and Maisto, 2009). This is especially problematic given that SMM account for two-thirds of all new HIV infections each year; HIV infections has increased recently among SMM (Centers for Disease Control and Prevention, 2013), and culturally sensitive services for SMM's alcohol and substance disorders are quite limited (Cochran et al., 2007). As such, there is an urgent need to advance the science of AUD among SMM and to identify potential etiological processes to inform intervention and prevention efforts.

Stress has been widely known to increase vulnerability to alcohol use disorder and its related consequences (Dawson et al., 2005; Pohorecky, 1991; Sinha, 2001, 2008), and it is also a common trigger for relapse (Sinha, 2001). However, the general research on stress and alcohol has found that the direct effects of stress on alcohol use are mixed (Brady and Sonne, 1999); thus, more research is needed to understand better the conditions in which stress is related to alcohol use. Examining the effects of stress on alcohol use among SMM is pertinent because meta-analyses show that SMM are more likely than heterosexuals to have higher rates of stressors commonly associated with AUD, such as childhood adversity, stressful adulthood events, and minority stressors (Friedman et al., 2011; Katz-Wise and Hyde, 2012; Keyes et al., 2011). However, limited research has examined the associations between stress and alcohol use among heavy drinking SMM more broadly and specifically on the daily level.

According to motivational models of alcohol use, individuals are motivated to drink to regulate their emotions by either drinking to cope with negative emotional experiences (e.g., daily stressors) or drinking to enhance positive emotional experiences, such as positive interpersonal interactions or celebrations (Cooper et al., 2000; Cooper et al., 1995).

Although research on motivational models of alcohol use reveals complex pathways in which general stress and positive and negative affect predict daily alcohol use (e.g., Armeli et al., 2000; Park et al., 2004; Simons et al., 2014), this literature is often limited to heterosexual and college student samples, mostly focuses on positive affect and drinking rather than positive events, and does not adequately account for individual differences, such as alcohol addiction severity (Armeli et al., 2005). Therefore, there is a need to examine additional conditions in which stress and positive events may or may not be associated with alcohol use for SMM.

Although alcohol use is conceptualized as a means to regulate or enhance emotion as described above (Cooper et al., 2000; Cooper et al., 1995), these associations are not uniformly supported by the literature, and their implications are not well studied among heavy drinkers. Alcohol addiction is on a continuum of severity (Koob, 2013); severe alcohol addiction creates negative emotional and physiological states that parallel the stress response and alter the physiological stress response systems (Koob, 2013), which may help explain the mixed associations between stressful events, positive experiences, and alcohol use. A more sophisticated examination of the relationships between stressful events, positive experiences, and drinking requires examining moderating factors, such as alcohol addiction severity, that may help explain the contexts in which these associations may exist.

The purpose of this paper is to examine the conditions under which daily stressful and positive events are associated with alcohol use among heavy drinking SMM. Specifically, we examined the moderating effects of two indicators of alcohol addiction severity (i.e., alcohol dependence severity and negative drinking consequences) on the associations between daily stressful events and alcohol use and between daily positive events and alcohol use among heavy drinking and treatment seeking SMM. We hypothesized: 1) daily stressful events would not be associated with daily drinking for heavy drinkers with high levels of alcohol dependence and negative drinking consequences, due to engrained compulsive drinking patterns; 2) daily stressful events would be associated with more daily drinking for SMM with lower levels of alcohol dependence and negative drinking consequences, as these individuals may be sensitive to stress-induced drinking; 3) consistent with motivations for drinking research (Cooper et al., 2000; Cooper et al., 1995),, daily positive events would be associated with more drinking for *all* heavy drinkers, given that drinking is more socially acceptable in positive contexts, yet this relationship may be more pronounced for heavy drinkers with low addiction severity rather than those with high addiction severity due to greater compulsive drinking patterns among this group.

2. Methods

Secondary data analyses were performed using data from a randomized controlled trial examining the combined effects of medication (naltrexone) and psychotherapy for problem drinking SMM seeking to reduce drinking. Detailed methods are described elsewhere (Morgenstern et al., 2012).

2.1. Participants

Recruitment targeted SMM who wished to reduce but not abstain from drinking via community outreach and print and online advertisements. Inclusion criteria required that participants: (1) were biologically male; (2) were over age 18; (3) drank an average weekly consumption of at least 24 standard drinks per week over the preceding 90 days; (4) identified as sexually active with other men; and (5) read English at an eighth-grade level or higher. Participants were excluded if they: (1) had a lifetime diagnosis of bipolar disorder, schizophrenia, or other psychotic disorder, an untreated current major depressive disorder; (2) had current physiological dependence on alcohol or other drugs (with the exception of nicotine or cannabis), operationalized as current physical withdrawal symptoms (measured by the Revised Clinical Institute Withdrawal Assessment for Alcohol; Sullivan et al., 1989, after 24 hours of abstinence) or report of a history of severe withdrawal (i.e., delirium tremens, seizures); (3) initiated or changed psychotropic medication in the preceding 90 days; (4) were at risk for serious side effects from naltrexone, such as those with severe liver abnormalities; (5) reported regular use of opioids; or (6) were enrolled in substance abuse treatment during the 12-week treatment phase of the study.

2.2. Sample Characteristics

Sample baseline demographics and clinical characteristics are presented in detail elsewhere (Morgenstern et al., 2012). Participants were 200 adults with a mean age of 40.3 years ($SD =$ 11.1). Participants were White (74%), Hispanic/Latino (13%), African American (10%), and Asian (3%). They reported their education level as: high school degree or GED or less (6%), some college education or associate's degree (17%), bachelor's degree (27%), or some graduate or professional school training (50%). Most participants were employed (76%), whereas 10% were unemployed/looking for work and 14% were not in the labor force/not looking for work. On average, participants had a baseline weekly consumption of 43.1 standard drinks ($SD = 25.4$) and drank 8.3 drinks per drinking day ($SD = 4.5$). Of the entire sample, 93% met criteria for DSM-IV alcohol dependence.

2.3. Procedures

Procedures complied with and approved by the institutional review board at New York State Psychiatric Institute. Potential participants were initially screened for study eligibility by telephone. Eligible participants were scheduled for an in-person interview. After providing informed consent, they were then assessed in depth for eligibility and medical safety to participate in the study. Two hundred eligible participants were urn randomized to treatment conditions. Detailed treatment procedures are described elsewhere (Morgenstern et al., 2012). Treatment (both medication and psychotherapy) lasted 12 weeks, with a follow-up assessment at one week after the end of treatment. Participants completed a battery of self-report questionnaires and an in-person interview at baseline and week 13 (end of treatment).

2.4. Daily Diary via Interactive Voice Recording Survey

During treatment, participants also responded to a daily survey delivered via interactive voice recording (IVR) (Telesage, 2005) each day of the twelve-week treatment period. Participants were provided a toll-free phone number and were asked to complete the survey

between 4:00 p.m. and 10:00 p.m. If participants failed to call into the system by 8:00 p.m., an automated reminder call was made. The daily surveys took about 2 to 5 minutes to complete. The compliance rate for the first seven days of the IVR, the period used for this study, was 77.1%.

2.5. Baseline, Cross-sectional Measures

2.5.1. Demographics—
Age and level of education were recorded via a self-report questionnaire at baseline.

2.5.2. Alcohol Dependence Scale—
The Alcohol Dependence Scale (ADS; Skinner and Horn, 1984) is a 25-item self-report measure used to assess the severity of alcohol dependence. Scores from the items were summed, ranging from 2 to 30, with scores below 13 indicating low symptomology that warrants only brief intervention. The ADS demonstrate high reliability and validity across substance using populations (Kahler et al., 2003). Cronbach's alpha for this study was .77.

2.5.3. The Short Inventory of Problems—
The Short Inventory of Problems (SIP; Miller et al., 1995) is a 15-item self-report measure of the past three months' negative consequences experienced from drinking. The SIP demonstrates strong psychometric properties (Kenna et al., 2005), and the Cronbach's alpha for this study was .88. Typical mean SIP scores for comparable samples of heavy drinkers is around 19 (e.g., Forcechimes et al., 2007).

2.5.4. Treatment—
Two dichotomous variables were used as covariates to indicate treatment assignment. One indicated medication, naltrexone or placebo, and the other indicated whether a participant received psychotherapy, yes or no.

2.5.5. Pre-Treatment Drinking—
Pre-treatment drinking was measured via the Timeline Followback Interview (TLFB; Sobell et al., 1980), covering the 90 days prior to the screening assessment. An average of drinks per drinking day over the entire TLFB assessment period was used as a covariate to account for baseline drinking levels.

2.6. Daily Diary Measures

2.6.1. Stressful Events—
Scores from three items measuring experienced stress were summed for a composite score. Items were in the last 24 hours, "Did you have or nearly have an argument or disagreement with anyone?", "Did anything else happen at home, work or school that you felt was stressful?" and "Did anything else happen to you that most people would consider stressful?" The response set was 0=No, 1=Yes, either last night or today, and 2=Both last night and today. Higher scores indicated more stress.

2.6.2. Positive Events—
Scores from three items measuring the occurrence of positive events were summed for a composite score. Items were in the last 24 hours, "Did you meet a goal or complete a task that left you with a sense of accomplishment?", "Did you have a pleasant interaction with a family member?", and "Did you have a pleasant interaction with

a friend or colleague?" The response set was 0=No, 1=Yes, either last night or today, and 2=Both last night and today. Higher scores indicated more positive events or experiences.

2.6.3. Weekday/Weekend—A dichotomous variable was used as a covariate to account for whether a day was a weekday, Sunday through Thursday, or a weekend day, Friday or Saturday.

2.6.4. Alcohol use—Alcohol use was measured via multiple items that asked participants to report the number of drinks they had in the last 24 hours by type of alcohol, wine, beer or liquor. Drinks were summed together to provide a daily amount. This variable was then lagged so that it indicated the number of standard drinks a person reported drinking in the next 24 hours (SSD).

2.7. Analytic Plan

Multilevel models (MLMs) with daily measures (level 1) nested within persons (level 2) were estimated in SAS 9.4 (SAS Institute Inc., 2002-2012), using the GLIMIX procedure.

MLMs account for the non-independence of observations due to nesting, are robust to missing data, and can model individual variability by including random coefficients (Gibbons et al., 2010; Raudenbush and Bryk, 2002; Singer and Willett, 2003). All models included random intercept terms to allow for individual variability in drinking levels. We also tested random slope terms, and due to poor model fit and lack of significance, they were excluded. A Poisson distribution with a log link function provided the best model fit. An unstructured variance-covariance matrix was specified, and all analyses utilized residual pseudo-likelihood estimation.

Only the first seven days of the IVR data were used for these models. Because our research questions focused on drivers of generally drinking, not in the context of treatment, we isolated the data to the time points with the least amount of treatment exposure. During this first week, participants had a maximum of one therapy session, and they had not yet titrated up to a full therapeutic dose of naltrexone (< 50 mg). Medication and therapy were entered into the model as covariates to account for their potential effects.

SSD was used as the outcome variable. After establishing that a random intercept was necessary for the best model fit, univariate associations between the variables of interest and drinking were explored first using independent multilevel models. Variables known to be associated with drinking, such as demographic variables (Kuerbis et al., 2012) and drinking day, such as whether a day was a weekend or weekday (Bolger and Laurenceau, 2013), were entered into the model as covariates. Of these potential covariates, the two treatment condition variables, weekday/weekend, and pre-treatment drinking remained as covariates in the models. Focal predictors were centered at the grand mean (person-level) and at the within-person level mean (daily level) to disaggregate daily and person-level effects (Bolger and Laurenceau, 2013). Stressful and positive events were entered independently, along with interaction terms with time.

Next, ADS was tested as a moderator of each focal predictor independently. The same procedure was used for the SIP. Where appropriate, significant interactive effects were probed by graphing the model-based expected SSD for interactions between variables. Finally, all terms in each of the independent moderation models that were significant at $p < .05$ were entered into a final model. The final model was reduced by eliminating the highest order interaction terms that were no longer significant.

3. Results

3.1. Descriptives

On average, close to one daily stressful event occurred in the last 24 hours ($M = .97$, $SD = 1.37$, Range: 0-6). Compared to daily stressful events, daily positive events were more common ($M = 2.5$, $SD = 1.5$, Range: 0-6). Average ADS scores were 13.8 ($SD = 5.4$), and average SIP scores were 16.1 ($SD = 7.8$).

3.2. Focal Predictors of Daily Drinking

Results of the independent MLMs of the focal predictors are presented in Table 1. Daily stressful events over time significantly predicted an increase in daily drinking. Daily positive events were significantly positively associated with drinking but not over time.

3.3. ADS as a Moderator

ADS was a significant independent moderator of the effects of daily stressful events on drinking (b = .01, SE = .002, p < .05). For those with high ADS scores, daily stressful events did not impact daily drinking. For those with low ADS scores, more daily stressful events predicted fewer drinks. ADS was not a significant moderator of the association between daily positive events and drinking.

3.4. SIP as a Moderator

SIP was a significant independent moderator of the effects of daily stressful events on drinking (b = .01, SE = .002, p < .01). For individuals with a high SIP score, daily stressful events did not impact daily drinking. For individuals with a low SIP score, more daily stressful events predicted fewer drinks.

SIP was also a significant independent moderator of the effects of daily positive events on drinking (b= .01, $SE = .002$, $p < .01$). For those with a high SIP score, more daily positive events increased daily drinking. For those with a low SIP score, daily positive events did not impact drinking.

3.5. Final Model

Table 2 shows the final model, which only included the highest order interaction terms that were significant. When all of the focal predictors and the significant interaction terms were entered into the model, only two moderating relationships of interest remained significant. Specifically, the moderating effect of ADS on daily stressful events and drinking (Figure 1) and the moderating effect of SIP on daily positive events and drinking (Figure 2) were significant and in similar patterns as the aforementioned independent models.

4. Discussion

This study extends the overall research on the daily associations between stressful events, positive experiences, and daily drinking among heavy drinkers as well as the research specific to SMM's hazardous drinking. We found that alcohol addiction severity can impact our understanding of when stressful and positive experiences are or are not related to daily drinking. Specifically, for heavy drinkers with high alcohol addiction severity, daily stressful events were not associated with alcohol use, and daily positive events were associated with increased alcohol use. In contrast, for heavy drinkers with low alcohol addiction severity, daily stressful events were associated with less drinking, and daily positive events were not associated with alcohol use. The findings have important clinical and research implications.

Our results indicated that daily stressful events predicted increases in daily drinking over time for all heavy drinking SMM; however, our moderation results indicated that this relationship varied based on alcohol addiction severity. A major contribution of our study, consistent with our hypotheses, is the finding that daily stressful events were not associated with daily alcohol use for individuals with high addiction severity—drinking levels remained relatively constant, regardless of daily stressful events. This is an important and novel finding, as it helps explain the mixed findings in the literature regarding the associations between stress and alcohol use, providing a better understanding for whom stress is *not* a factor in increasing alcohol use. Individuals with severe AUD have entrenched, and compulsive drinking patterns (Koob, 2013) and these patterns may nullify or override the impact of daily stress. Thus, stress may influence the initiation of early drinking behaviors and may serve as a predictor of relapse but may not necessarily contribute to the maintenance of long-term alcohol misuse among heavy drinkers with high addiction severity.

In contrast to our hypotheses, we found that daily stressful events were associated with less alcohol use for heavy drinkers with low alcohol addiction severity. These individuals may drink less to avoid negative drinking consequences, possibly because they recognize that drinking heavily may potentially inhibit their ability to resolve or cope with the stressors they are experiencing. However, it is important to note that although these findings were statistically significant, they lack clinical significance as the decreases in drinking were less than one standard drink per day.

Consistent with positive and social motivations for drinking research (Cooper et al., 2000; Cooper et al., 1995), our findings indicate that daily positive events were associated with increased drinking for SMM with higher addiction severity. Specifically, we found that positive events were associated with increased daily drinking only for heavy drinkers with high levels of alcohol-related problems rather than low alcohol-related problems. Given that drinking is more socially acceptable in positive contexts, heavy drinkers with high addiction severity may be more likely to drink in these contexts, whereas heavy drinkers with low addiction severity may exert some control over their drinking behaviors. However, it is important to note that although this interaction was statistically significant, it was not clinically significant as the change in standard drinks was only a change in about one standard drink per day, which is within a context of drinking about 8 drinks per day.

Nonetheless, more research is warranted to discern which types of positive events and the context of these events that may be specific risk factors for increased drinking for individuals with higher addiction severity; this will allow for valuable information to determine whether these are clinically relevant findings. Moreover, clinicians should assess both stressful and positive events in their work and explore with their clients if and how these events may specifically be related to their drinking behaviors.

The results of this study are constrained by its limitations. First, our sample was of mostly White SMM who were treatment seeking, who met criteria for DSM-IV alcohol dependence and were already engaged in high levels of drinking (an average of 43.1 drinks per week), which limits its generalizability to other SMM. Future research should examine the associations between stressful and positive events and drinking among racially diverse SMM, SMM who are not treatment seeking, and SMM with heterogeneous levels of addiction. Second, our study examined SMM daily experiences once daily and over only one week of assessments, which limited the frequency of events we were able to capture (on average about one stressful event and one positive event, respectively). Future research is needed to examine SMM daily experiences over an extended period to gain a better a richer understanding of their behaviors and how their frequency might impact drinking behaviors. Additionally, expanding this use of momentary ecological assessment from a daily diary method to a more frequent and fine-grained assessment throughout the day would provide more information about momentary associations between stressful and positive events and drinking in real time.

Third, our study measured limited general types of stressful and positive events, which were selected on the basis of face validity. It remains unknown whether other types of events, whether positive or stressful, would have yielded different results. Similarly, our assessment was of stressful and positive events more generally; thus, we did not examine whether these types of events were specifically related to being a sexual minority (e.g., minority stress or identity-affirming events). Although it is possible that we captured minority stressors in our measures, future research is needed to examine and discern between multiple and specific types of stressful and positive events, such as SMM-specific stressful experiences (e.g., stigma-based and minority stressors), and the role alcohol severity may play on the effects stressors unique to SMM on their drinking. Additionally, future research is needed to discern participants' attributions of these events better. Fourth, psychometric properties of single-item measures are difficult to obtain (Wanous and Hudy, 2001). In the context of repeated daily assessments, they may be impossible to ascertain, particularly reliability, as responses to these measures are expected to change quite dramatically from observation to observation. Given these limitations, findings should be interpreted with the appropriate caution.

Despite its limitations, our study has several strengths. Most of the research on sexual minorities' drinking behaviors has largely focused on examining sexual orientation disparities in drinking; although this work is important, our study is novel because it moves beyond documenting disparities and examines specific factors that contribute to SMM's drinking.

Specifically, our study is the first to examine the effects of both stressful and positive events on drinking among heavy drinking SMM, as well as the role of alcohol addiction severity in explaining the effects of these events on drinking. Furthermore, our use of daily assessments provided a richer understanding of these factors and SMM's experiences in their natural environment. Our findings are also noteworthy for the general literature on drinking and addiction as our study helps contribute a refined understanding of the conditions in which stress and positive events may or may not predict drinking.

Acknowledgments

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Highlights

- A daily dairy study of daily alcohol use among heavy drinking sexual minority men.

- Stressful and positive events were both associated with daily drinking.

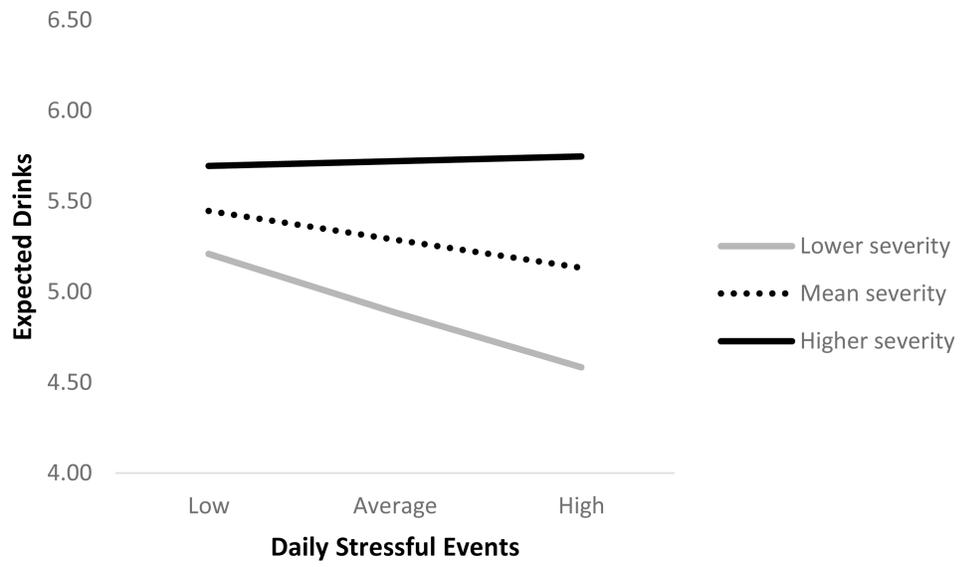- Addiction severity moderated associations between these events and drinking.

Figure 1.
Final model based expected drinks for daily stressful events by Alcohol Dependence Scale (ADS) score interaction. For both variables: Low = -1 SD, High = +1 SD.
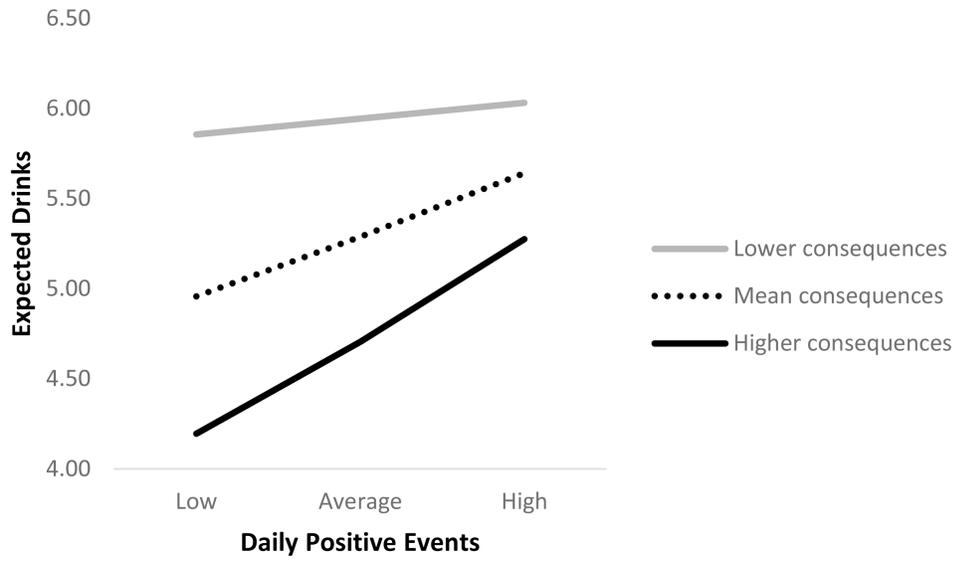
Figure 2.
Final model based expected drinks for daily positive events by Short Inventory of Problems (SIP) interaction. For both variables: Low = -1 SD, High = +1 SD.

Table 1

Parameter estimates (and Standard Errors) of Independent Multilevel Models of Subsequent Drinks

Models	B	SE	t	P
Stressful Events				
Intercept	1.5	.10	15.3	< .001
Person-average	.05	.06	.86	.39
Daily Stressful Events	−.02	.01	−1.7	.09
Daily Stressful Events*Time	.02	.01	2.1	< .05
Positive Events				
Intercept	1.5	.10	15.2	< .001
Person-average	.01	.05	.10	.92
Daily Positive Events	.05	.01	3.15	< .01
Daily Positive Events*Time	−.00	.01	-.08	.93

Note. Daily-level variables were centered at the person mean, and person-average variables were centered at the grand mean. All models controlled for treatment, pre-treatment drinking, weekday/weekend, and age.

Table 2

Parameter estimates (and Standard Errors) of Final Multilevel Model of Subsequent Drinks

Model	B	SE	t	P
Intercept	1.57	.10	16.3	< .0001
Person-average ADS	.01	.01	1.14	.25
Person-average SIP	-.02	.01	-1.77	.07
Person-average Stressful Events	.07	.07	1.04	.30
Daily Stressful Events	-.04	.01	-2.54	< .05
Person-average Positive Events	-.02	.05	-.39	.70
Daily Positive Events	.04	.01	2.35	< .05
ADS * Daily Stressful Events	.01	.002	2.43	< .05
SIP * Daily Positive Events	.01	.002	2.53	< .05

Note: The above model controlled for treatment condition (NTX and therapy), age, baseline drinking, and weekday/weekend. Time

[*] Daily Stressful Events was also retained in the model as a covariate and remained significant in this final model. ADS=alcohol dependence scale, SIP=Short Inventory of Problems.